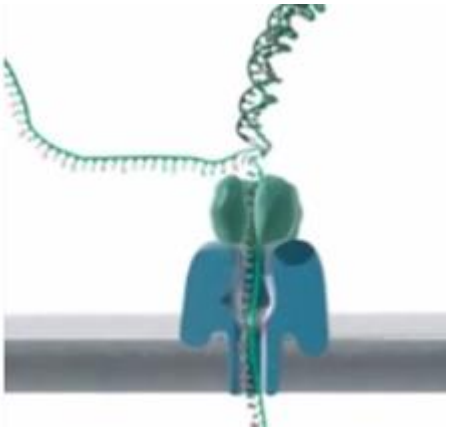
The MinION

What is it?

The MinION is a portable sequencing device from Oxford Nanopore Technologies, Ltd., that fits easily in the palm of your hand. Powered by USB and based on nanopore technology, the MinION sequences native DNA or RNA and does not require amplification, making it easy for scientists to take genomics outside the lab and into the field.

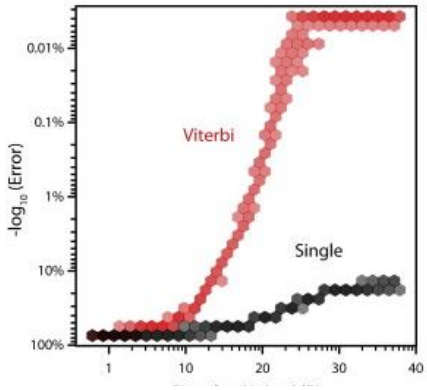
How does it work?

Protein nanopores are synthesized and inserted into an electrically resistant polymer membrane. An electric potential is applied to the membrane, creating a current across the nanopore. DNA is "unzipped" and a single strand is fed through the nanopore one base at a time. Each base creates a characteristic disruption in the electric current as it passes through the nanopore, which is measured by an electrode. The sequence of disruptions is then interpreted as a DNA sequence[1].



A single strand of DNA is fed through a nanopore and bases are identified by their characteristic disruption of an electric current that runs through the nanopore.

The MinION is unique among sequencing platforms in that it does not require the shearing or cutting of DNA into smaller fragments (ex. <150bp fragments in Illumina sequencers). Thus, there is no genome aligning or assembly required and no limit to the size of the sequence – some reporting reads as long as 10Mb!



Statistical models like the Viterbi algorithm greatly improve the error rate of the MinION,

Is it trust worthy?

Base-calling using the MinION can be problematic as the current disruptions measured at the nanopore do not give single base resolution. MinION sequencers have an estimated 38.2% error rate using a single current measurement[2]. But, advances in statistical modeling have shown that current signals can be decoded using Hidden Markov Models and can greatly improve base-calling, giving accuracies up to 98%[3]. Additionally, the MinION can be used to enhance the continuity of de novo assemblies when run in conjunction with Illumina platforms.

What have people used it for?

The MinION is fully scalable and can be run with many machines in tandem, vastly increasing throughput, analysis speed, or both. Researchers have used the MinION in pathogen surveillance (including the recent Ebola outbreak in western Africa)[4], genetic barcoding for ecosystem inventory[5], as well as a cheap and quick way to perform "routine" genomic analyses (e.g. mutation detection, copy number variants, exon mapping, etc.).

[1]DNA: Nanopore Sequencing. Oxford Nanopore Technologies Ltd. [2]Laver, T. *et al.* Assessing the performance of the Oxford Nanopore Technologies MinION. *Biomolecular Detection and Quantification* **3**, 1-8, doi:http://dx.doi.org/10.1016/j.bdq.2015.02.001 (2015). [3]Timp, W., Comer, J. & Aksimentiev, A. DNA Base-Calling from a Nanopore Using a Viterbi Algorithm. *Biophysical Journal* **102**, L37-L39, doi:http://dx.doi.org/10.1016/j.bpj.2012.04.009 (2012).[4]Greninger, A. L. *et al.* Rapid metagenomic identification of viral pathogens in clinical samples by real-time nanopore sequencing analysis. *Genome Medicine* **7**, doi:10.1186/s13073-015-0220-9 (2015).[5]Ramgren, A. C., Newhall, H. S. & James, K. E. DNA barcoding and metabarcoding with the Oxford Nanopore MinION. *Genome* **58**, 268-268 (2015).